

Application No. 10/553,689
Amendment Dated: March 3, 2008
Reply to the Office Action of December 3, 2007

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Listing of the Claims:

1. (Previously Presented) A gas phase olefin polymerization process comprising:
(1) preparing a solution of a catalyst precursor comprising a mixture of magnesium and titanium compounds, an electron donor and a solvent;
(2) adding a filler to the solution from step (1) to form a slurry;
(3) spray drying the slurry from step (2) at a temperature of 100 to 140°C to form a spray dried precursor;
(4) slurrying the spray dried precursor from step (3) in mineral oil,
(5) partially pre-activating the catalyst precursor by contacting the slurry of step (4) with one or more Lewis Acids employing one or more in-line static mixers, wherein the molar ratio of the Lewis Acid to the electron donor in the catalyst precursor is about 0.1:1 to about 0.3:1; and

(6) transferring the partially pre-activated catalyst precursor from step (5) under plug-flow conditions into a gas phase, olefin polymerization reactor and adding an additional amount of the activator to the reactor to produce a homogeneous activated catalyst mixture, wherein the molar ratio of the Lewis Acid to the electron donor after the additional amount of activator is added is about 2:1 to about 50:1, and wherein the catalyst is partially pre-activated in step (5) for a short residence time to minimize deactivation of the catalyst of about 1 minute to about 6 hours prior to the transferring step (6).

2. (Previously Presented) The gas phase olefin polymerization process of Claim 1, wherein the filler comprises a porous catalyst support.

3. (Previously Presented) The process of claim 1 wherein;

1) the catalyst precursor in step (1) corresponds to the formula:



wherein R is an aliphatic or aromatic hydrocarbon radical having 1 to 14 carbon atoms or COR' wherein R' is a aliphatic or aromatic hydrocarbon radical having 1 to 14 carbon atoms and each OR group is the same or different;

M is a transition metal;

X is independently chlorine, bromine or iodine;

ED is an electron donor;

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d is 0.5 to 56;

e is 0, 1, or 2;

f is 2 to 116;

g is >2 and up to $1.5(d)+3$; and

2) the Lewis Acid of step (5) is

i) one or more compounds with formula $M'(R''_n)X_{(3-n)}$ wherein M' is aluminum or boron; each X is independently chlorine, bromine, or iodine; each R'' is independently a saturated aliphatic hydrocarbon radical having 1 to 14 carbon atoms, provided that when M is aluminum, n is 1 to 3 and when M is boron, n is 0 to 1.5; and

ii) is added in an amount such that the mole ratio of total Lewis Acid to electron donor in the precursor is from about 0.1:1 to about 0.3:1.

4. (Previously Presented) The process of claim 1, wherein said Lewis Acid is;

one or more alkylaluminum compound(s) with formula $M'(R''_n)X_{(3-n)}$ wherein M' is aluminum, R'' is n-butyl, n-hexyl, n-octyl, iso-octyl, isohexyl, or n-decyl, X is Cl or Br and n is a number from 0 to 1.5.

5. (Previously Presented) The process of claim 4, wherein said Lewis Acid is selected from the group consisting of triethylaluminum, tri-n-butyl aluminum, tri-n-hexyl aluminum, tri-n-octyl aluminum, tri n-decyl aluminum, triisoprenyl aluminum, dimethyl aluminum chloride, ethylaluminum dichloride, diethylaluminum chloride, and mixtures thereof.

6. (Previously Presented) The process of claim 1, wherein the catalyst precursor is partially preactivated by first contacting with diethylaluminum chloride followed by tri-n-hexyl aluminum.

7. (Previously Presented) The process of claim 1, wherein the viscosity of the slurry after addition of the activator or activators in step (5) is adjusted to at least 1500 cP.

8. (Previously Presented) The process of claim 1 in which the slurry of step (4) is intimately mixed with the Lewis Acid in step (5) by use of one or more vertically disposed static mixers.

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9. (Previously Presented) The process of claim 1 wherein the one or more static mixers and connecting piping have length/diameter ratios from 5 to 15.

10. (Previously Presented) The process of claim 1 in which said gas phase reactor is the sole olefin polymerization reactor.

11. (Previously Presented) The process of claim 1 wherein two olefin polymerization reactors are employed.

12. (Previously Presented) The process of claim 1, wherein the activator includes a Lewis Acid having the formula $M'(R''_n)X_{(3-n)}$ wherein

M' is aluminum;

each X is independently chlorine, bromine, or iodine;

each R'' is independently a saturated aliphatic hydrocarbon radical having 1 to 14 carbon atoms; and

n is 1 to 3; and

wherein the catalyst is partially pre-activated in step (5) for about 15 minutes to about 45 minutes prior to the transferring step (6).

13. (Previously Presented) The process of claim 1, wherein a polymer comprising ethylene produced according to the process of claim 1 has a quantity of fines that is at least 10 percent less than the quantity of fines in a polymer produced under a comparative process under the same conditions except that the comparative process does not include the partial pre-activation of the catalyst precursor according to step (5) of the process of claim 1.

14. (Previously Presented) A gas phase olefin polymerization process comprising:

(1) preparing a solution of a catalyst precursor comprising a mixture of magnesium and titanium compounds, an electron donor and a solvent;

(2) adding a filler to the solution from step (1) to form a slurry;

(3) spray drying the slurry from step (2) at a temperature of 100 to 140°C to form a spray dried precursor;

(4) slurring the spray dried precursor from step (3) in mineral oil,

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(5) partially pre-activating the catalyst precursor by contacting the slurry of step (4) with one or more Lewis Acids employing one or more in-line static mixers, wherein the molar ratio of the Lewis Acid to the electron donor in the catalyst precursor is about 0.1:1 to about 0.3:1; and

(6) transferring the partially pre-activated catalyst precursor from step (5) under plug-flow conditions into a single gas phase, olefin polymerization reactor and adding an additional amount of the activator to the reactor to produce a homogeneous activated catalyst mixture, wherein the molar ratio of the Lewis Acid to the electron donor after the additional amount of activator is added is about 3:1 to about 20:1, wherein the catalyst is partially pre-activated in step (5) for a short residence time to minimize deactivation of the catalyst of about 1 minute to about 6 hours prior to the transferring step (6), and wherein said gas phase reactor is the sole olefin polymerization reactor.

15. (Previously Presented) The gas phase olefin polymerization process of Claim 14, wherein the filler comprises a porous catalyst support.

16. (Previously Presented) The process of claim 14 wherein;

1) the catalyst precursor in step (1) corresponds to the formula:



wherein R is an aliphatic or aromatic hydrocarbon radical having 1 to 14 carbon atoms or COR' wherein R' is a aliphatic or aromatic hydrocarbon radical having 1 to 14 carbon atoms and each OR group is the same or different;

M is a transition metal;

X is independently chlorine, bromine or iodine;

ED is an electron donor;

d is 0.5 to 56;

e is 0, 1, or 2;

f is 2 to 116;

g is >2 and up to 1.5(d)+3; and

2) the Lewis Acid of step (5) is

i) one or more compounds with formula $\text{M}'(\text{R}'')_n\text{X}_{(3-n)}$ wherein M' is aluminum or boron; each X is independently chlorine, bromine, or iodine; each R'' is independently a

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saturated aliphatic hydrocarbon radical having 1 to 14 carbon atoms, provided that when M is aluminum, n is 1 to 3 and when M is boron, n is 0 to 1.5; and

ii) is added in an amount such that the mole ratio of total Lewis Acid to electron donor in the precursor is from about 0.1:1 to about 0.3:1.

17. (Previously Presented) The process of claim 14, wherein said Lewis Acid is; one or more alkylaluminum compound(s) with formula $M'(R''_n)X_{(3-n)}$ wherein M' is aluminum, R'' is n-butyl, n-hexyl, n-octyl, iso-octyl, isohexyl, or n-decyl, X is Cl or Br and n is a number from 0 to 1.5.

18. (Previously Presented) The process of claim 14, wherein said Lewis Acid is selected from the group consisting of triethylaluminum, tri-n-butyl aluminum, tri-n-hexyl aluminum, tri-n-octyl aluminum, tri n-decyl aluminum, triisoprenyl aluminum, dimethyl aluminum chloride, ethylaluminum dichloride, diethylaluminum chloride, and mixtures thereof.

19. (Previously Presented) The process of claim 14, wherein the catalyst precursor is partially preactivated by first contacting with diethylaluminum chloride followed by tri-n-hexyl aluminum.

20. (Previously Presented) The process of claim 14, wherein the activator includes a Lewis Acid having the formula $M'(R''_n)X_{(3-n)}$ wherein

M' is aluminum;

each X is independently chlorine, bromine, or iodine;

each R'' is independently a saturated aliphatic hydrocarbon radical having 1 to 14 carbon atoms; and

n is 1 to 3; and

wherein the catalyst is partially pre-activated in step (5) for about 15 minutes to about 45 minutes prior to the transferring step (6).

21. (Previously Presented) The process of claim 14, wherein a polymer comprising ethylene produced according to the process of claim 14 has a quantity of fines that is at least 10 percent less than the quantity of fines in a polymer produced under a comparative process

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under the same conditions except that the comparative process does not include the partial pre-activation of the catalyst precursor according to step (5) of the process of claim 14.